The Wilma H. Schiermeier Olentangy River Wetland Research Park: Progress Report for 2005

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Summary

This publication offers the fourteenth consecutive annual report on teaching, research, service, and development at the Wilma H. Schiermeier Olentangy River Wetland Research Park (ORWRP). It covers progress in calendar year 2005, the twelfth year of hydrologic operation of the two 2.5-acre experimental wetland "kidneys" on the site, the ninth year of ecological development of our 7-acre mitigation wetland "billabong," the seventh year of the Sandefur Wetland Pavilion, and the third year of occupancy of the Heffner Wetland Research and Education Building.

Twenty-nine courses from 8 OSU Colleges (FAES, MAPS, ENG, BIO, SBS, VM, EDU, ART) and other Ohio institutions used the ORWRP in 2005 for college courses. Four master's degrees and one Ph.D. in wetland science were completed in 2005 (Mitsch and Hitzhusen, advisors), raising the total number of theses and dissertations completed at the ORWRP to 49. Two short courses on wetland restoration and wetland delineation were taught in 2005 to 37 participants from 13 states/provinces. One hundred and twenty-seven tours or presentations of the ORWRP were given in 2005 to 2600 participants as public outreach. Ralph Tiner from Massachusetts presented an outdoor Moonlight on the Marsh lecture on August 17, 2005 to 100 attendees. ORWRP graduate students presented 16 papers at 3 national/international conferences in 2005 and generated 345 credit hours of 999 research.

Grants and contracts totaling $0.9 million were active at the ORWRP in 2005, including research on hydrologic pulsing effects on wetlands, water quality improvement in Costa Rica, and restoration of the Cuyahoga River and Darby Creek in Ohio, the Mississippi River Basin, the Louisiana Delta, Delaware Bay in New Jersey, and the Iraqi Mesopotamian Marshlands.

Donations of over $200,000 were secured in 2005. The direct economic impact of the ORWRP to The Ohio State University from grants, contracts, development, and short course fees over its 14-year history is almost $8 million. Its contribution to wetland management and education of the public and students alike on restoration and protection of wetlands and rivers in Ohio and the country is worth far more than that.

Why a Wetland Research Park?

Wetlands are shallow to intermittently flooded ecosystems that are more commonly known by such terms as swamps, bogs, marshes, and sedge meadows. They are revered as important parts of the natural landscape because of their functions in cleaning and retaining water naturally, preventing floods, and providing a habitat and food source for a wide variety of plant and animal species. It is estimated that more than half of the original wetlands in the lower 48 states have been lost to drainage projects and human development projects. Ohio has lost about 90 percent of its original wetlands.

When we lose wetlands, we lose their ability to provide clean water, prevent floods, and enhance biological diversity. Many organizations are calling for creation and restoration of wetlands to clean up our streams, rivers, and lakes and to provide lost habitat. The National Academy of Sciences called for the restoration and creation of 10 million acres of wetlands in the United States by the year 2010 (NRC, 1992). Five million acres of wetlands in the Mississippi River Basin have been suggested as being necessary to help prevent the dead zone, or hypoxia, in the Gulf of Mexico (Mitsch et al., 2001; Mitsch and Day, 2006). The U.S. Army Corps of Engineers oversees a regulatory program that results in tens of thousands of acres of wetlands being restored and created each year to replace wetlands that are lost to development. Furthermore, the largest wetland restoration in the world, at costs that will exceed $10 billion, is underway in the Florida Everglades.

A National Academy of Sciences panel (NRC, 2001) determined that much more research is needed before we can be assured that those wetlands that are constructed to replace wetlands destroyed for development can be successful. Even though a recent report by the U.S. Fish & Wildlife Service (Dahl, 2006) suggested that there was a net gain of wetlands in the United States from 1998 to 2004, the definition of what is defined as a wetland remains controversial, as does the question of whether we can create and restore wetlands, and that report was roundly criticized.

The Schiermeier Olentangy River Wetland Research Park exists to understand: 1) how wetlands work; 2) if we can create and restore them; and 3) the best approaches to creation and restoration of wetlands. It is a long-term, large-scale wetland research facility; there is no other facility of its kind on any other university campus in the world.

History of OSU's Wetlands

The Olentangy River Wetland Research Park is located

Figure 1. Aerial photograph of Olentangy River Wetland Research Park, Ohio State University, July 2005.

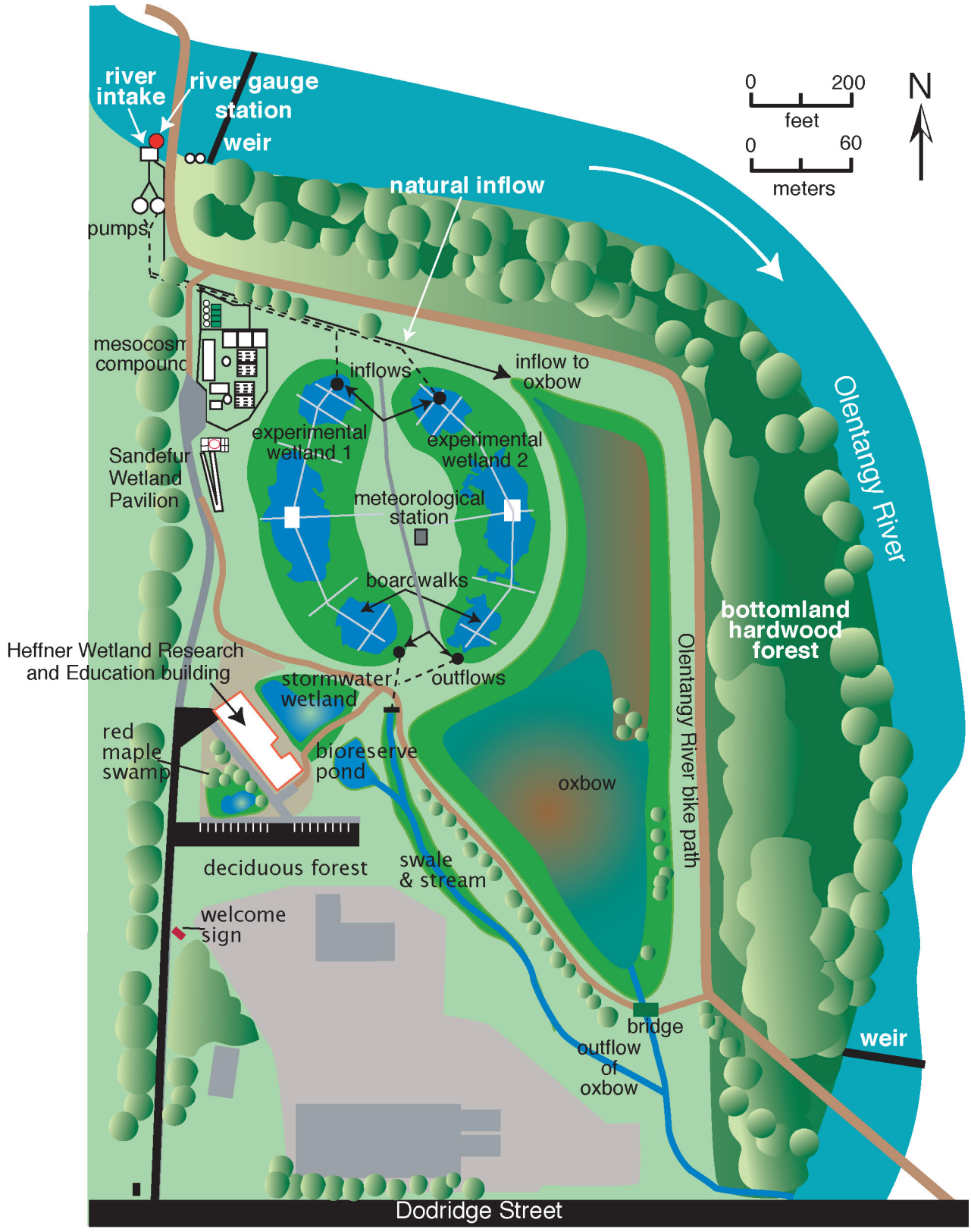

Figure 2. Wilma H. Schiermeier Olentangy River Wetland Research Park, 2005.

on a 30-acre site owned by the Ohio State University, immediately north of Dodridge Road and adjacent to the Columbus campus (Figures 1 and 2). The site was developed in three phases:

Phase 1—Construction of two experimental wetland basins and their water delivery system;

Phase 2—Development of a research and teaching infrastructure at the site, including boardwalks, experimental mesocosms, a plant-material greenhouse, additional wetlands, instrumentation for long-term research, and a visitor pavilion; and

Phase 3—Development and construction of the Wetland Research and Education Building on the site.

Phase 1 of site development, which featured construction of two 2.5-acre deepwater marshes and a river water delivery system, was completed in 1994. Pumps were installed on the floodplain to bring water from the Olentangy River to the wetlands and pumping officially began on March 4, 1994. River water is pumped continuously, day and night, into the two wetlands. It then flows by gravity back to the Olentangy River through a swale and constructed stream system. In May 1994, one wetland basin was planted with marsh vegetation typical of wetlands in the Midwest; the other remained as an unplanted control.

Phase 2, establishing the infrastructure for research and education of the site, began in 1994 and was completed with the dedication of the Sandefur Wetland Pavilion in 1999. That phase also included the construction of the 7-acre naturally flooded billabong and construction of the mesocosm compound.

Phase 3, the construction of the $2.8 million Wetland Research and Education Building at the ORWRP, began with the receipt of $1.18 million in two Hayes Investment Fund grants from the Ohio Board of Regents in 1999 and 2000. The grants were the result of an effort of a 5-university consortium of Ohio institutions—Ohio State, Wright State, Shawnee State, Youngstown State, and Kenyon College. Additional support for the building was obtained through donations, pledges, and a loan from OARDC. The decision to go forward with building construction was made on December 13, 2001. Construction began in spring 2002 and staff and students moved into the building on March 6, 2003. As the building was created, three additional wetlands were created in the vicinity of the building including a stormwater wetland that receives runoff from the roof of the new building.

Teaching

Teaching in a "living laboratory" setting has been an emphasis at the Olentangy River Wetland Research Park since its inception. Formal OSU courses including wetland ecology, water quality, ecological engineering, anthropology, architecture, general chemistry, wildlife management, animal ecology, groundwater hydrology, geography, ornithology, geography, and forestry. Twenty-nine courses involving 661 students formally used the site in 2005 (Table 1), an increase from 400 students from 24 courses that used the wetlands in 2003. Classes were from 8 OSU Colleges (Food, Agricultural, and Environmental Sciences; Biology; Engineering; Math and Physical Sciences; Education; Veterinary Medicine; Social and Behavioral Sciences, Art). Classes from Capital University and Columbus State also used the wetlands for field trips in 2005. In addition, about 345 hours of 999 graduate research was completed in 2005 at the ORWRP.

A total of 49 students have completed dissertations, master's theses, or honors undergraduate theses with partial or full use of the Olentangy River Wetland Research Park from 1992 through 2005 (Table 2). Four master's students and one Ph.D. student completed their degrees in 2005 including a graduating class of three graduate students in December 2005 (Figure 3). While most students writing theses are from Ohio State departments, there have been five students from Europe (two from the UK, three from Denmark) and one student from China who have collected research data at the ORWRP.

Wetland Professional Short Courses

Two short courses were taught in 2005 at the ORWRP—Wetland Delineation and Wetland Creation and Restoration. The courses are taught in the conference room in the Heffner Wetland Building and attracted 37 participants from 13 states. Participants were primarily from environmental consulting firms and state and Federal agencies and they indicated high satisfaction with the content and locations of the courses. In addition, a short course on wetland modelling and restoration was taught in Amman, Jordan, to a class of 12 Iraqi water managers (Figure 4). This course taught them techniques that would be useful in the restoration of the Mesopotamian marshlands in Iraq.

Research

Over $0.9 million in contracts and grants were active at the ORWRP in 2005 (Table 3). The projects included two research projects on site (Figure 5): a bottomland hardwood forest restoration supported by Ohio Department of Transportation, and a USDA wetland pulsing experiment in the experimental wetlands and billabong. The hydrologic pulsing study supported by the U.S. Department of Agriculture (USDA) NRI program involved hydrologic pulses in the winter/spring of 2004 and no pulses in 2005. Preliminary results of that research are included in the 2004 annual report (Mitsch et al., 2005a) and some early publications (e.g., Mitsch et al., 2005b). In addition, other wetland and river projects active in 2005 included the rehabilitation of the Cuyahoga River in Cleveland, Ohio (Mitsch et al., 2005c; Figure 6), the restoration of the Mesopotamian Marshlands of Iraq (Jørgensen et al., 2005; Santiago-Fandino, 2005), the restoration of Delaware Bay salt marshes (Hinkle and Mitsch, 2005), and improving water quality with wetlands at EARTH University in Costa Rica (Nahlik and Mitsch, in review; Figure 7). Publications

Table 1. Formal class use of Olentangy River Wetland Research Park, 2005.

Term	Course	Number of students	Instructor and College
Winter 2005	Chemistry 221 General Chemistry	40	Susan Olesik MAPS
	NR 797B Wetland and River Restoration	12	William Mitsch FAES
	NR 693 Independent Research-ORW projects	3	William Mitsch FAES
	Entomology 102 Insect Biology II	15	Dave Horn BIOL
	ES/NR 999 Independent Research	9	William Mitsch FAES
	AEDE 999 Independent Research	1	Fred Hitzhusen FAES
Spring 2005	EEOB 322 Introduction to Ormithology	86	John Condit BIOL
	Vet Medicine VMC 700.08	26	Cliff Monahan VM
	EEOB 210 Local Flora	42	Elizabeth Harris BIOL
	LARCH 323	8	Brooks Breeden ENG
	LARCH 622 Landscape Architecture	38	Brooks Breeden ENG
	Environmental Geography 210	60	Bryan Mark MAPS
	ES/NR 999 Independent Research	9	William Mitsch FAES
	GEOG H410	20	Ellen Mosely-Thompson SBS
Summer 2005	ES/NR 999 Independent Research	9	William Mitsch FAES
	EEOB 210 Local Flora	15	Liz Harris BIOL
	Vet Medicine 700.08	12	Cliff Monahan VM
	OSU- Science Education	6	Dr Thompson EDU
	SNR Orientation	10	FAES
	Introduction to Biology	10	BIOL
Autumn 2005	Vet Medicine 700.08	12	Cliff Monahan VMI
	Geography 210 Environmental Geography	50	Bryan Mark SBS
	NR 725 Wetland Ecology and Management	33	William Mitsch FAES
	EEOB 661 Conservation Biology	60	John D. Harder BIOL
	ES/NR 999 Independent Research	9	William Mitsch FAES
	NR 893 Independent Study	6	William Mitsch FAES
	Art and the Environment (special class)	20	Shely Castro ART
	Ecology Field Class	20	Alan Stan Capital University
	Introduction to Biology	20	Columbus State Comm Col
	total number of students	661	
	number of courses	29	
	number of OSU colleges	8	

Table 2. Theses and dissertations completed at the Olentangy River Wetland Research Park through 2005.

Ph.D. dissertations (11)

* **Christopher J. Anderson** "The influence of hydrology and time on productivity and soil development of created and restored wetlands" Ph.D. dissertation, School of Environment and Natural Resources (2005)
- **Deni Porej** "Faunal aspects of wetland creation and restoration" Ph.D. dissertation, Evolution, Ecology, and Organismal Biology (2004)
- **Changwoo Ahn** "Ecological engineering of wetlands with a recycled coal combustion byprooduct" Ph.D. dissertation, Environmental Science Graduate Program (2001)
- **John J. Gutrich** "Ecological and economic analysis of natural capital: Assessing and modeling the substitutability of mitigation wetlands for natural sites" Ph.D. dissertation, Department of Agricultural, Environmental, and Developmental Economics (2000)
- **Michael A. Liptak** "Water column productivity, calcite precipitation, and phosphorus dynamics in freshwater marshes" Environmental Science Graduate Program (2000)
- **Douglas J. Spieles** "Nutrient retention and macroinvertebrate community structure in constructed wetlands receiving wastewater and river water" Environmental Science Graduate Program (1998)
- **Randall J.F. Bruins** "Modeling of flooding response and ecological engineering in an agricultural wetland region of Central China" Environmental Science Graduate Program (1997)
- **Neal E. Flanagan** "Comparing ecosystem structure and function of constructed and naturally occurring wetlands: Empirical field indicators and theoretical indices" Environmental Science Graduate Program (1997)
- **Robert W. Nairn** "Biogeochemistry of newly created riparian wetlands: evaluation of water quality changes and soil development" Environmental Science Graduate Program (1996)
- **Naiming Wang** "Modelling phosphorus retention in freshwater wetlands" Environmental Science Program (1996)
- **Paul E. Weihe** "Colonizing and introduced vegetation in created riparian wetlands: Establishment during the first two growing seasons" Environmental Science Graduate Program (1996)

Master's theses (22)

- **Cassandra L. Tuttle** "The effects of hydrologic pulsing on aquatic metabolism in created riparian wetlands" Environmental Science Graduate Program (2005)
- **Amanda M. Nahlik** "The effects of river pulsing on sedimentation in two created riparian wetlands" Environmental Science Graduate Program (2005)
- **Rebecca Swab** "Effectiveness of *Lonicera maackii* removal from a bottomland hardwood forest in central Ohio" School of Environment and Natural Resources (2005)
- **Tracy J. Tenwalde** "Averting and treatment costs regarding nitrogen risk in public water supplies in Columbus, Ohio: Implications for wetland nitrogen sequestration" Department of Agricultural, Environmental, and Development Economics (2005)
- **Eric Lohan** "A methodology to ecologically engineer watersheds for nitrogen nonpoint source pollution control" Environmental Science Graduate Program (2004)
- **Mark Dilly** "Atrazine fate in a created wetland" Environmental Science Graduate Program (2003)
- **Sarena M. Selbo** "Hybridization between native and introduced populations of cattail and big bluestem: Conservation implications, Evolution, Ecology, and Organismal Biology (2002)
- **Cheri Higgins** "Ecosystem engineering by muskrats (*Ondatra zibethicus*) in created freshwater marshes" Environmental Science Graduate Program (2002)
- **Amie M. Gifford** "The effect of macrophyte planting on amphibian and fish community use of two created wetland ecosystems in central Ohio" Environmental Science Graduate Program (2002)
- **Daniel F. Fink** "Efficacy of a newly created wetland at reducing nutrient loads from agricultural runoff" Environmental Science Graduate Program (2001)
- **Matthew Cochran** "Effect of hydrology on bottomland hardwood forest productivity in central Ohio (USA)" Natural Resources (2001)
- **Sarah K. Harter** "Patterns of short-term sedimentation in a freshwater created marsh" Natural Resources (1999)
- **Sharon A. Johnson** "Effects of hydrology and plant introduction on first-year macrophyte growth in a newly created wetland" Natural Resources (1998)
- **Lisa J. Svengsouk** "First-year response of *Typha latifolia* L. and *Schoenoplectus tabernaemontani* (K.C. Gmel.) Palla to nitrogen and phosphorus additions in experimental mesocosms" Environmental Science Graduate Program (1998)
- **Kathleen D. Metzger** "Self-design of a fish community in a created riparian freshwater marsh: A simulation model" Environmental Science Graduate Program (1997)
- **John S. Koreny** "Hydrology of a constructed riparian wetland system: Characterization and predictive modeling" Environmental Science Graduate Program (1996)
- **Uygar Özesmi** "A spatial habitat model for the marsh-breeding red-wing blackbird (*Agelaius phoeniceus*) in coastal Lake Erie wetlands" Environmental Science Graduate Program (1996)
- **Doreen M. Dudek** "Tree growth responses to streamflow in a bottomland forest in central Ohio" Natural Resources (1995)
- **Steven F. Niswander** "Functional analysis of a created in-stream mitigation wetland: hydrology, phosphorus retention, and tree growth" Natural Resources (1994)

- **Renée F. Wilson** "Progress and success of five mitigation wetlands in Ohio" Natural Resources (1995)
- **Karen M. Wise** "Evaluation of acid mine drainage control by a constructed wetland in southeastern Ohio" Natural Resources (1994)
- **Frank D. Voss** "Groundwater investigation of Ohio State University wetland site" Geodetic Science (1993)

Undergraduate honors theses (10)
- **Katherine E. Kleber** "Fish population and movement within planted and naturally colonizing experimental wetlands, autumn 2000" Natural Resources (2000)
- **Erika A. Filippi** "The role of soil organic matter on denitrification potential in newly created wetlands" Natural Resources (1998)
- **Bonnie F. Elfritz** "A comparison of natural wetlands with a constructed wetland using the Floristic Quality Assessment Index" Natural Resources (1998)
- **Kimberly K. Schamp** "Groundwater patterns before and after wetland construction at the Olentangy River Wetland Research Park" Natural Resources (1997)
- **Nicole L. Vorwerk** "Comparison of three years of pH values between planted and unplanted wetlands at the Olentangy River Wetland Research Park" Natural Resources (1997)
- **Rainie D. Gardner** "Fish recruitment in the Olentangy River constructed wetlands" Natural Resources (1997)
- **Tonya Cheek** "Effect of fish on wetland water quality" Natural Resources (1996)
- **Andrew W. Wehr** "Early water quality of created wetlands at the Olentangy River Wetland Research Park" Natural Resources (1995)
- **Michael E. Berkal** "Hydrology and water chemistry of the Olentangy River in Worthington (Franklin County), Ohio, and their potential effects on a future constructed wetlands facility downstream in Columbus, Ohio" Natural Resources (1992)
- **Douglas G. Stuart** "Intensive water quality sampling in two constructed riparian wetlands" Natural Resources (1992)

Theses/research at other universities (6)
- **Chuan Li** "Research in forests at Xiashu urban forest in Jiangsu province, China" College of Forest Resources and Environment, Naijing Forestry University (in progress)
- **Rikki Bronnum** "The effects of alachlor on denitrifying bacteria in mesocosms and created wetlands in central Ohio, USA" Master's Thesis, Environmental Chemistry, University of Copenhagen (2001)
- **Hojeong Kang** "The significance of enzyme activities in wetland biogeochemistry" University of Wales, UK (1999)
- **Pernille Mortensen** and **Pernille Lanzky** "Water quality improvement in a constructed wetland" Thesis, Royal Danish School of Pharmacy, Copenhagen, DENMARK (1996)
- **Rebecca Smith** "Nitrogen transfer in groundwater in the riparian zone of the Olentangy River, Columbus, Ohio" Thesis, Cambridge University, Cambridge, England, UK (1996)

Figure 3. Autumn quarter 2005 Ohio State University graduates from Olentangy River Wetland Research Park program, December 11, 2005. left to right Chris Anderson (Ph.D. in Environment and Natural Resources), Cassie Tuttle (M.S. in Environmental Science), Amanda Nahlik (M.S. in Environmental Science), and Professor Bill Mitsch, Environment and Natural Resources.

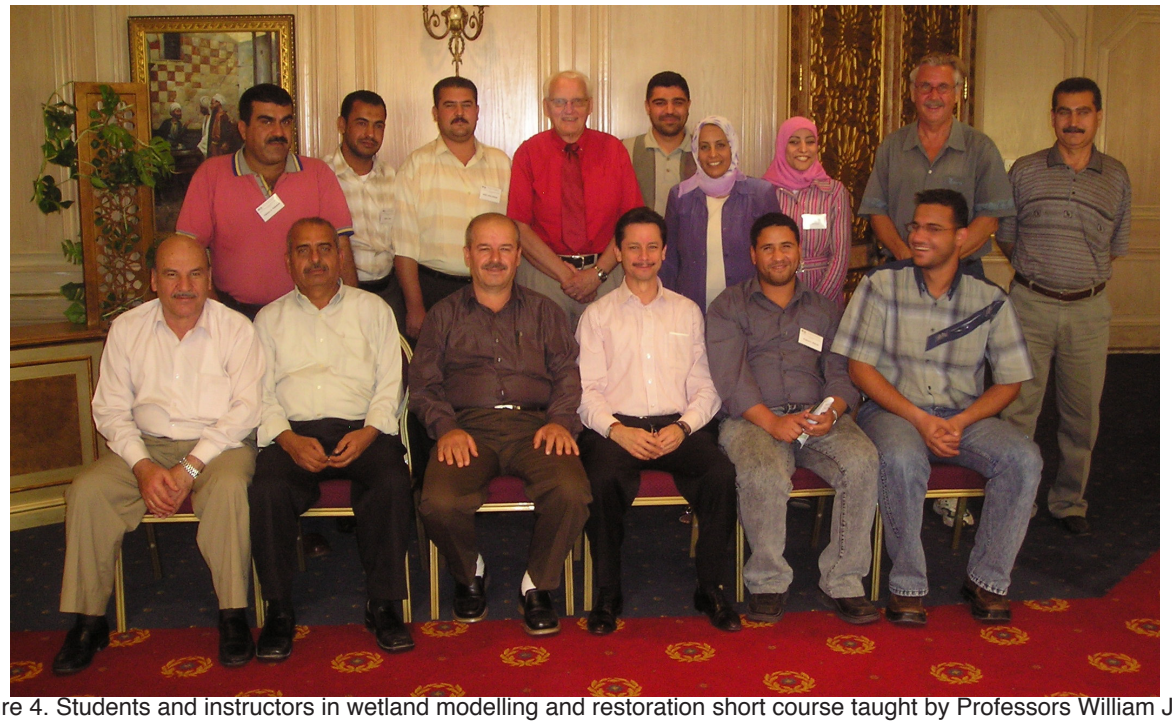

Figure 4. Students and instructors in wetland modelling and restoration short course taught by Professors William J. Mitsch (Ohio State University) and Sven E. Jørgensen (University of Copenhagen) in Amman, Jordan. Students were from water and environmental ministries of the Iraqi government.

Table 3. Funded research projects active at the Olentangy River Wetland Research Park in 2005.

RF #	Short title	Funding Source	College	Amount	end date
746414	Research in the Humid Tropics	U.S. Dept of Energy	FAES	$482,000	5/31/06
60004294	Environmental management Iraqi marsh	Univ of Copenhagen	FAES	$26,208	12/31/05
60004041	Regeneration zone for Cuyahoga River	Rocky Mountain Institute	FAES	$14,600	12/31/05
746935	Renewable energy project at the ORWRP	Ohio Dept of Development	FAES	$24,036	6/30/06
745333	Importance of hydrologic pulsing	USDA	FAES/MAPS	$272,000	8/31/06
738587	Wetland monitoring and management	Ohio Dept of Transportation	FAES	$74,967	5/4/06

Figure 5. Graduate students Chris Anderson (left) and Anne Altor (right) conducting wetland research in the ORWRP bottomland forest during flooding and in the experimental wetlands.

Figure 6. ORWRP Directors Bill Mitsch (left) and Li Zhang (right) touring the Cuyahoga River in Cleveland with undergraduate honors student Jim Hamski, in the vincinity of the infamous Cuyahoga River fires of the 1960s. The ORWRP conducted a study of potential restoration scenarios for the Cuyahoga River in 2005.

Figure 7. Graduate student Amanda Nahlik takes a water sample at a treatment wetland on the campus of EARTH University in Costa Rica as EARTH students assist. The ORWRP has established a robust tropical wetland research collaboration on this campus with Department of Energy support.

were developed for other projects on Darby Creek in central Ohio (Zhang et al., 2005), the Louisiana Delta (Orth et al., 2005), and the Mississippi River Basin (Day et al., 2005; Mitsch et al., 2005d; Mitsch and Day, 2006).

Public Outreach

The ORWRP was involved in several significant public activities in 2005. On March 8, 2005, President Karen Holbrook hosted a public celebration of the 2004 Stockholm Water Prize with a reception adjacent to her office in Bricker Hall (Figure 8). The event was attended by ORWRP scientists and students, advisory committee members, and several OSU faculty and staff.

A "Moonlight on the Marsh" invited lecture, sponsored by Jerry and Lenora Pausch, was held at the ORWRP in 2005. Wetland ecologist and long-time OSU short course instructor Ralph Tiner presented "The Isolated Wetland Connection" on August 17, 2005 at the Sandefur Wetland Pavilion at the ORWRP (Figure 9). Ralph W. Tiner is a nationally recognized expert in wetland delineation, which he has taught since the early 1980s. As a member of the Federal Interagency Committee on Wetland Delineation, he was compiler and principal author of the federal interagency wetland delineation manual published in 1989. He is Adjunct Professor at the University of Massachusetts and the author of several wetland books. The seminar was preceded by a "picnic at the swamp" event open to the public. Approximately 100 people attended the lecture.

Formal tours and presentations of the ORWRP continued to be among our popular public service activities in 2006 (Figures 10–12). The ORWRP conducted 127 tours and/or public presentations on the Olentangy River Wetland Research Park in 2005 to almost 2600 participants (Table 4). Groups receiving tours ranged from Audubon/COSI Museum children tours to two Japanese families associated with Honda Inc. Since 1994, the ORWRP has led over 1115 wetland tours and presentations to over 21,000 individuals (Figure 13).

Several distinguished scientists visited the wetlands in 2005 including: Wilfredo Colon (Universidad del Este, Puerto Rico); Bob Costanza (University of Vermont); Tom Headley (Southern Cross University, Australia) and several participants at the American Ecological Engineering Society (AEES) annual meeting. We were also the feature field for 30 visitors from the 79th annual Ohio Water Environment Association Conference in June 2005.

Publications/Scholarly Presentations

Publications from the ORWRP in 2005 included one book (Mitsch, 2006) eleven peer-reviewed papers, four technical reports, and five theses/dissertations added to the ORWRP reprint collection in 2005 (Table 5).

The AEES annual meeting was hosted by Ohio State University on May 18–20, 2005 and was attended by over 100 individuals from all over the USA and several foreign countries. Both the AEES social event and the final day discussion were held at the ORWRP (Figure 14). Twelve papers were presented at this meeting by ORWRP personnel, with eight of those as poster presentations by graduate students. Another six oral papers were presented by ORWRP staff and graduate students at the 90th Annual Meeting Ecological Society of America /IX INTECOL Congress, in Montreal, Canada, August 9–12, 2005 (Figure 15). In total, ORWRP graduate students presented 16 papers in 2005 at the AEES meeting in Columbus, the Society of Wetland Scientists meeting in Charleston, SC, and the Ecological Society of America meeting in Montreal. Professor Mitsch gave 17 invited presentations around the world in 2005 including presentations in France, Sweden, Spain, China, and Costa Rica (Figure 16).

Publicity

The Olentangy River Wetland Research Park and its research and teaching were publicized nine times during 2005 in newspaper articles, press releases, and other publications (Table 6). Copies of some of the articles related to ORWRP activities in 2005 are given in the Appendix. The ORWRP receives attention every home football game as students assist in parking cars at the ORWRP (Figure 17).

Yvonne Baskin, a noted science writer from Bozeman, MT who spent several weeks as a visitor gathering data at the ORWRP in 2004, published her book "Under Ground: How Creatures of Mud and Dirt Shape Our World" (Baskin, 2005). Chapter 10 in that book, entitled "Microbes, Muck, and Dead Zones" is mostly about research at the Olentangy River Wetlands.

Development

The Olentangy River Wetland Research Park has been supported in its 15 years of development (1991-2005) by thousands of private donations to the University. Through December 2005, over $4 million in cash and in-kind support has been raised for the wetland project (Table 7), almost all from corporations and individuals. In 2005, there were 377 donations, the most ever, totaling $208,000. In 2004, there were 332 donations totaling $1,689,049, with most of that being the Schiermeier endowment; in 2003, donations totaled $361,000.

Over the years, about 15% of the ORWRP donations (equivalent to almost $600,000) received at the ORWRP have been as in-kind contributions. In-kind support obtained over the years includes donation of 4.9 acres of land on the southeastern corner of the ORWRP adjacent to river (value of $75,000), two four-wheel drive vehicles, construction of the billabong wetland, groundwork and gravel for the new building, a paved driveway (Heffner/Agg Rok), and civil engineering for building construction (Bischoff Miller Inc.). By the end of 2005, all of a $330,000 loan from OARDC for the Heffner Wetland Building has been paid back.

Figure 8. Reception held by Ohio State University President Karen Holbrook in recognition of Dr. Mitsch's 2004 Stockholm Water Prize. Top, attendees listen to short presentations by Dr. Holbrook. Bottom, Prof. Mitsch presents a framed copy of an aerial photograph of the Olentangy River Wetland Research Park to Dr. Holbrook.

Figure 9. Moonlight on the Marsh distinguished lecture by Ralph Tiner, noted wetland scientist from Massachusetts, held at the Olentangy River Wetland Research Park, August 17, 2005. Top left: lecture actually occurred during moonlight over the marsh; top right: Raph Tiner during his lecture; bottom, Lecture and audience at the Sandefur Wetland Pavilion.

Table 4. Tours and presentations of the Olentangy River Wetland Research Park in 2005

Date	note	Organization	Est. #
1/3/05	*	University of Florida grad students	2
1/4/05	*	The Other Paper, Reporter	1
1/11/05	*	Blanca Bernal-Martinez, OSU student researcher	1
1/14/05	*	Channel 10 reporter and cameraman	2
1/14/05	*	Kathy Remins, Friends of Lower Olentangy Watershed (FLOW)	1
1/14/05	**	Samual Traina, University of California, Merced	1
1/17/05	***	Rotary Club of Columbus, Hyatt Regency	250
1/20/05	*	Heather Starck, Columbus Audubon	1
1/21/05	*	Hector Santiago, Franklin Soil and Water Conservation	1
1/22/05	***	Scholar's Luncheon, Ohio Union Ballrooms	20
2/16/05	*	Vince Messerly, Ohio Wetlands Foundation	1
2/18/05	*	Kevin Lunde, Hawaii, potential student	1
2/22/05	*	EEOB graduate student recruits	15
2/22/05	*	Otterbein College, Environmental Biology, Dr. Douglass Kane	10
3/3/05	**	Dr. Wilfredo Colon, Universidad del Este, Puerto Rico	1
3/3/05	*	Group of Professors from Puerto Rico, Dr Hitzhusen (Ag. Eng., Carolina, PR)	4
3/18/05	*	OARDC (ORW Conference Room)	15
3/21/05	*	Vet medicine (VM700.08)	6
3/23/05	*	Harmon Middle School	20
3/28/05	*	Communication and technology Customer Service Group	10
3/31/05		Upper Arlington High School	30
4/3/05	*	International Conference for Landscape Architecture Students - Tony Murry	40
4/5/05	*	Fairfield Middle School, Leesburg, OH	20
4/6/05	*	Vet medicine (VM700.08)	16
4/7/05	*	Global Water Issues, Friendship Village, Westerville Marilyn Walburn	35
4/8/05	*	Cub Scout Pack 180, Columbus	10
4/11/05	*	EEOB 322 Introduction to Ormithology	10
4/12/05	*	EEOB 322 Introduction to Ormithology	10
4/13/05	*	EEOB 322 Introduction to Ormithology	10
4/13/05	*	OSU Retirees Association (Frank Allaire)	23
4/14/05	*	EEOB 322 Introduction to Ormithology	10
4/15/05	*	Harmon Middle School	50
4/15/05	*	LARCH 343 (Stephen Turk)	10
4/15/05	*	EEOB 210 Local Flora Elizabeth Harris	20
4/16/05	*	Ohio Center for Wetland and River Restoration 3rd annual meeting	16
4/19/05	*	Worthington Historical Society	19
4/21/05	**	Robert Costanza, University of Vermont	20
4/23/05	*	ORW tour (SNR new undergrads and families)	60
4/27/05	*	Nilesen Environmental Field School Inc.	15
4/28/05	*	Nilesen Environmental Field School Inc.	15
5/2/05	*	EEOB 322 Introduction to Ormithology	11
5/2/05	*	OARDC (Conference room)	11
5/3/05	*	Geog H410 (Ellen Mosley - Thompson)	20
5/3/05	*	EEOB 322 Introduction to Ormithology	11
5/3/05	*	Tom Wilkinson - OARDC	3
5/4/05	*	EEOB 322 Introduction to Ormithology	11
5/4/05	*	Columbus Public School teachers, Lisa Sieberling	34
5/5/05	*	EEOB 322 Introduction to Ormithology	12
5/6/05	*	FFA Ohio State perspective students (Lucy Bowens)	18
5/10/05	*	Upper Arlington Elementary School	22
5/10/05	*	Northside Childcare Columbus	10
5/10/05	*	Washington Courthouse, TAG students - Kim Adams	25
5/10/05	*	UA Schools (80 students, Jane Hunt, River sampling)	80
5/10/05	*	Upper Arlington High School	25
5/11/05	***	UA Public Library talk, Nancy Hertschorn	40
5/12/05	***	Knowledge Bank, OSU Libraries	50
5/13/05	*	Landscape Architecture 322/622 (Brooks Breeden)	37
5/16/05	*	Teays Valley Schools (Marilyn Clifton)	28
5/16/05	*	Columbus Rotory (Lisa Westwater)	3

Figure 10. Tour of ORWRP by Japanese tourists from the Honda Family Center, May 2005.

5/17/05	*	Tom Headley, Southern Cross University, Australia	1
5/18/05	*	AEES Annual Meeting-ORW tour	40
5/18/05	*	AEES Annual Meeting/social event	100
5/19/05	**	AEES Annual Meeting- Eco Eng discussion, conference room	30
5/25/05	*	Honda Family Center - Rob Horsburgh	7
5/26/05	*	Olentangy Local Elementary School	50
5/27/05	*	Geography 210, April Luginbuhl	30
5/27/05	*	Geography 210, April Luginbuhl	30
6/4/05	*	ORW Advisory Committee meeting	10
6/9/05	*	Dirt Crew Gardners (Dan Zerkel)	16
6/14/05	*	OARDC	30
6/16/05	*	Teacher's tour	10
6/17/05	*	Shaw Yu, University of Virginia	8
6/17/05	*	Tolls Technical	50
6/22/05	*	79th Annual Ohio Water Environment Association Conference	30
6/23/05	*	Sally Joslyn, UA Schools	10

Figure 11. Prof. Mitsch leads a tour of ORWRP by Cub Scout pack 180 from Columbus.

6/23/05		Hilliard High School	1
6/23/05	*	Science Library, 6 participants	6
6/28/05	*	Audubon & COSI	20
6/28/05	*	Audubon & COSI	20
6/28/05	*	Creation and Restoration of Wetlands Short Course	15
7/7/05	*	Jim Dowdy, SNR alum prof	1
7/14/05	*	Hilliard Public Schools - Gifted Summer School	17
7/19/05	*	Central State Univeristy	3
7/20/05	**	Audubon & COSI	20
7/20/05	*	Honda Family Center	10
7/20/05	*	Shiela Gosset, National Congressional Office	12
8/2/05	*	Audubon & COSI	20
8/2/05	*	Marcelita Haskins, WOSU	3
8/3/05	*	Audubon & COSI)	20
8/4/05	*	Martin Essex, Workshop on the Wetlands	20
8/10/05	*	Pat Marida, Sierra Club	20

8/15/05	**	Wetland Delineation Short Course	19
8/17/05	*	Ralph Tiner, Moonlight on the Marsh	100
8/22/05	*	Korean Student Deligation	6
8/23/05	*	OSU Statistics Department	2
8/29/05	*	Carly Rospert	1
9/6/05	*	Channel 4	2
9/6/05	*	Nonie Rinboski and Karen Volemar	2
9/10/05	*	Clyde Dilley, Wild Ones	2
9/13/05	*	Alan Stan Capital University, Ecology Field Class	20
9/14/05	*	Army Corps of Engineers, ODOT, and Fish and Wildlife Service	5
9/19/05	*	Georgetown instructors visitation	5
9/20/05	*	Franklin Garden Club	45
9/28/05	*	Northwest Garden Club	18
10/3/05	***	OWLS Class at Thurber Village	50
10/6/05	*	The Schiermeier Family	2
10/10/05	***	OWLS Class at Thurber Village	50
10/10/05	*	Raul Botero Botero, EARTH University	1
10/12/05	*	Shelly Castro, The Wexner Center, Art and the Environment	20
10/14/05	*	Ohio State University Women's Club; Garden Club	20
10/17/05	***	OWLS Class at Thurber Village	50
10/17/05	*	Terry Noteand Margaret Odell, Joyce Foundation	2
10/18/05	***	Chimes Junior Class Honorary	5
10/18/05	*	Laura Backus, Carter and Burgess	3
10/24/05	***	OWLS Class at Thurber Village	50
10/25/05	***	Johan Leller, NOVA	1
10/28/05	*	Geography 210, Physical Geography and the Environment	20
10/28/05	*	Geography 210, Physical Geography and the Environment	30
10/28/05	*	Cub Scout Group	11
11/4/05	*	2nd and 3rd Graders	30
11/7/05	*	Westminster OWLS program	20
11/9/05	*	Carlos Hernandez, EARTH University	1
11/10/05	*	Sara Matherey	31
11/18/05	*	Cub Scout Group	15
11/22/05	*	Lucy Ferly	8
12/1/05	*	Columbus State Intro Biology Julie Cronk	20
12/1/05	*	Debbie Hughes	5
			___
		TOTAL	2585
		# of Tours/Presentations	127

*site tour
**site tour with visiting scientist or distinguished visitor
*** off-site presentation

Figure 12. The Ruth Smart Lobby of the Heffner Wetland Building is often used for part of a wetland tour at the ORWRP.

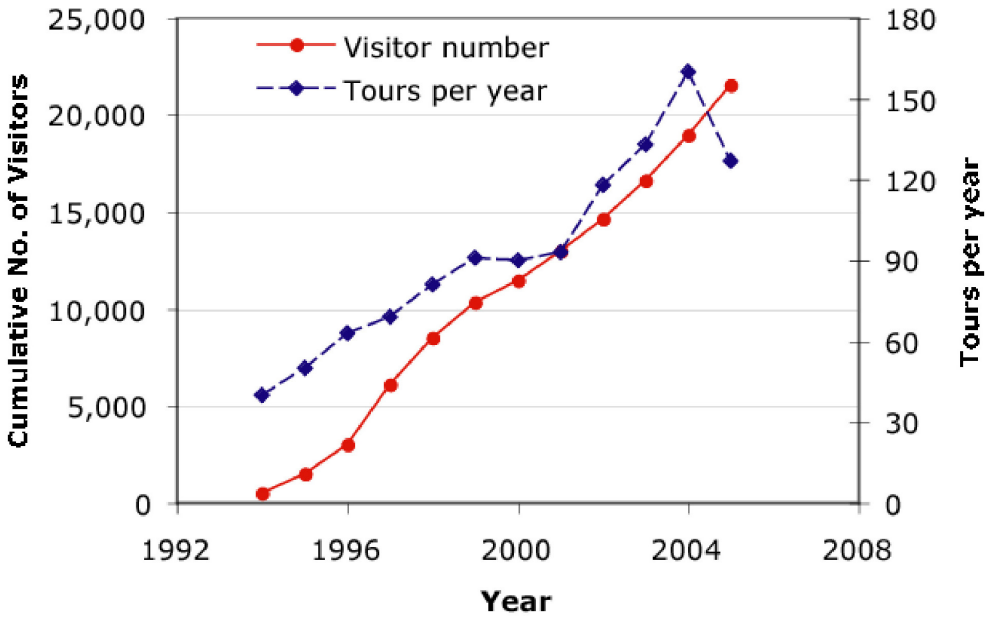

Figure 13. Annual ORWRP tours/presentations and cumulative number of participants, 1994-2005.

Table 5. Publications and theses supported at the Olentangy River Wetland Research Park in 2005

Papers

05-011 Orth, K., J.W. Day, D.F. Boesch, E.J. Clairain, W.J. Mitsch, L. Shabman, C. Simenstad, and B. Streever. 2005 Lessons learned: An assessment of the effectiveness of a National Technical Review Committee for oversight of the plan for the restoration of the Mississippi Delta. Ecological Engineering 25: 153-167.

05-010 Mitsch, W.J., L. Zhang, C.J. Anderson, A. Altor, and M. Hernandez. 2005. Creating riverine wetlands: Ecological succession, nutrient retention, and pulsing effects. Ecological Engineering 25: 510-527.

05-009 Anderson, C.J. and W.J. Mitsch. 2005. Effect of pulsing on macrophyte productivity and nutrient uptake: A wetland experiment. American Midland Naturalist 154: 305-319.

05-008 Anderson, C.J., W.J. Mitsch, and R.W. Nairn. 2005. Temporal and spatial development of surface soil conditions at two created riverine marshes. Journal of Environmental Quality 34: 2072-2081.

05-007 Mitsch, W.J. 2005. Applying science to conservation and restoration of the world's wetlands. Water Science & Technology 51 (8): 13-26.

05-006 Hinkle, R. and W.J. Mitsch. 2005. Salt marsh vegetation recovery at salt hay farm wetland restoration sites on Delaware Bay. Ecological Engineering 25: 240-251.

05-005 Zhang, L., W.J. Mitsch, and D.F. Fink. 2005. Hydrology, water quality, and restoration potential for the Upper Big Darby Creek, Central Ohio. Ohio J. Science 105:46-56.

05-004 Mitsch, W.J., J.W. Day, Jr., L. Zhang, and R. Lane. 2005. Nitrate-nitrogen retention by wetlands in the Mississippi River Basin. Ecological Engineering 24: 267-278.

05-003 Day, J.W., Jr., J. Barras, E. Clairain, J. Johnston, D. Justic, G. P. Kemp, J.-Y. Ko, R. Lane, W.J. Mitsch, G. Steyer, P. Templet, and A. Yañez-Arancibia. 2005. Implications of global climatic change and energy cost and availability for the restoration of the Mississippi Delta. Ecological Engineering 24: 253-265.

05-002 Mitsch, W.J. 2005. Wetland creation, restoration, and conservation: A Wetland Invitational at the Olentangy River Wetland Research Park. Ecological Engineering 24: 243-251.

05-001 Day, J.W., Jr., G. Abrami, J. Rybczyk and W.J. Mitsch. 2005. Venice Lagoon and the Po Delta: System functioning as a basis for sustainable management. In: Flooding and Environmental Challenges for Venice and its Lagoon, Fletcher and Spencer, eds. Cambridge University Press, Cambridge, England. pp. 445-459.

Theses and Dissertations

Cassandra L. Tuttle "The effects of hydrologic pulsing on aquatic metabolism in created riparian wetlands" Master's Thesis, Environmental Science Graduate Program, The Ohio State University. Advisor: William J. Mitsch

Amanda M. Nahlik "The effects of river pulsing on sedimentation in two created riparian wetlands" Master's Thesis, Environmental Science Graduate Program, The Ohio State University. Advisor: William J. Mitsch

Christopher J. Anderson "The influence of hydrology and time on productivity and soil development of created and restored wetlands" Ph.D. dissertation, School of Natural Resources, The Ohio State University. Advisor: William J. Mitsch

Rebecca Swab " Effectiveness of Lonicera maackii removal from a bottomland hardwood forest in central Ohio " Master's Thesis, School of Natural Resources, The Ohio State University. Advisor: William J. Mitsch

Tracy J. Tenwalde "Averting and treatment costs regarding nitrogen risk in public water supplies in Columbus, Ohio: Implications for wetland nitrogen sequestration" Master's Thesis, Agricultural, Environmental, and Development Economics, The Ohio State University. Advisor: Fredrick J. Hitzhusen

Figure 14. Participants at American Ecological Engineering Society (AEES) meeting held at Ohio State University May 18–20, 2005 at the ORWRP. The ORWRP was the site of the meeting social event and the last day discussions. Twelve presentations and posters were given by ORWRP scientists and students at this meeting.

Figure 15. ORWRP graduate students, faculty, and alumni at Ecological Society of American/ International Association of Ecology annual meeting in Montreal, Quebec, Canada, August 12, 2005. Left to right, Maria Hernandez, Li Zhang, Bill Mitsch, Dan Fink, Amanda Nahlik, Anne Altor, and ORWRP alum Changwoo Ahn. Dr. Ahn is assistant professor at George Mason University.

Figure 16. International travel for conferences for Prof. Mitsch in 2005 included Left, an International Symposium on Shallow Lakes in Nanjing, China on April 24–27, 2005 (left to right, Bill Mitsch, Yan Jingsong, Sven Jørgensen), and Right, a return to the 2005 Stockholm Water Prize ceremony on August 25, 2005 in Stockholm Sweden (left to right, SWP laureates Sven Jørgensen (Denmark), Peter A. Wilderer (Germany), Bill Mitsch (USA).

Future Plan

Plans are underway to construct a bikepath shelter on the city bikepath that cuts through the ORWRP (Figure 18). The facility, to be constructed in 2006, will have solar collectors on the roof for supplying power to displays related to the wetlands.

Beginning with 2006, emphasis at the ORWRP will be focused in three directions:

• use of the site facilities for continued experiments at mesocosm and full scale;

• integration of wetland science for the benefit of the state of Ohio; and

• an increased emphasis on wetland conservation and restoration throughout the world.

ORWRP's Impact

Through 2005, the economic and academic impacts of the ORWRP on Ohio State University and the world of wetland science have been significant. Over its development and operation, the ORWRP has resulted in the following economic advantages to the University:

Wetland Short Course Fees	$230,000
Extramural Grants and Contracts	$3,500,000
Donations	$4,100,000
Total impact	$7,830,000

Over the period 1992–2005, the project has also been responsible for the following academic achievements that cannot always be assigned economic value:

• completion of 49 graduate and undergraduate student theses and Ph.D. dissertations. Most are at OSU but the total include five from European institutions;

• publication of 126 papers listed in the ORWRP reprint series,

• completion of 14 comprehensive annual reports summarizing all research accomplished at the ORWRP,

• leadership of over 1100 formal wetland tours and presentations for the public to an estimated 21,000 individuals, including K–12 students, university students, garden clubs, campus visitors, and Federal, state, and local public officials.

• provision of a convenient set of campus ecosystems in support of over 210 Ohio State University classes in eight university colleges and several courses from other Ohio institutions.

• provision of a controlled research site for more than 120 students doing independent research for theses and dissertations. The ORWRP has supported the research and teaching programs of more than 40 OSU professors and senior researchers from several OSU Colleges and scientists from other Ohio institutions.

• education of 310 agency personnel, consultants, and students in 21 wetland short courses taught since 1996.

• development of the fields of wetland science and ecological engineering to the point where they have led to a significant improvement in Ohio's and the nation's environment.

Figure 17. ORWRP graduate students help with automobile parking before Ohio State University football games.

References

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Dahl, T.E. 2006. Status and trends of wetlands in the conterminous United States 1998 to 2004. U.S. Department of the Interior; Fish and Wildlife Service, Washington, D.C. 112 pp.

Day, J.W., W.J. Mitsch, R.R. Lane, and L. Zhang. 2005. Restoration of wetlands and water quality in the Mississippi-Ohio-Missouri (MOM) River Basin and Louisiana Delta. Final Report to Louisiana Department of Natural Resources, Baton Rouge, LA, Olentangy River Wetland Research Park, The Ohio State University and School of Coast and Environment, Louisiana State University, 18 pp. + appen.

Hinkle, R. and W.J. Mitsch. 2005. Salt marsh vegetation recovery at salt hay farm wetland restoration sites on Delaware Bay. Ecological Engineering 25: 240-251.

Jørgensen, S.E., W.J. Mitsch, L. Zhang, D. Gamble, and C.L. Tuttle. 2005. Handbook on Phytotechnology for Water Quality Improvement and Wetland Management through Modelling Applications. United Nations Environmental Programme, International Environmental Technology Centre, Shiga Prefecture, Japan, 239 pp.

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Mitsch, W.J., L. Zhang, C.J. Anderson, A. Altor, and M. Hernandez. 2005b. Creating riverine wetlands: Ecological succession, nutrient retention, and pulsing effects. Ecological Engineering 25: 510-527.

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Table 6. Press and media coverage of the Olentangy River Wetland Research Park, 2005

Date	Article Title or Event	Publication
January 6, 2005	"Bringing Eden back: Professor helps in effort to restore Iraq's Mesopotamian marshlands"	onCampus
January 27, 2005	"When bland works: AIA awards include an unlikely star"	The Other Paper
March 20,2005	"Ohio State makes a marsh: Plant, wildlife populations mature over 11 years"	The Cincinnati Enquirer
May 3, 2005	"Restoring Eden: Worldwide effort begins to bring back Iraqi Wetlands"	The Columbus Dispatch
Spring 2005	"79th Annual Conference: Ohio Water Environment Association"	Buckeye Bulletin
June 30, 2005	"Dewine announces federal funding for central Ohio project"	Press release of Senator Dewine
July 14, 2005	"Pryce Secures Environmental Provision Involving OSU in Water Bill"	News from the office of Congresswoman Deborah Pryce
September 10, 2005	"Ohio scientist, others call for big changes to New Orleans land"	The Columbus Dispatch
October 1, 2005	"Restoring our wetlands"	The Irish Times (Dublin, Ireland)

Table 7. Donation support for the Olentangy River Wetland Research Park through 2005.

Year	Number of donations	Total amount of donations	In-kind donations*	Endowment donations	Non-building donations**	Building fund
2005	377	$207,972	$4000	$2381	$201,591	
2004	332	$1,689,049	$0	$1,518,536	$155,406	$15,107
2003	289	$361,569	$71,403	$50,956	$108,687	$130,523
2002	264	$365,056	$80,510	$ 445	$20,143	$263,933
2001	319	$248,416	$75,000	$1,140	$9,984	$162,292
2000	250	$237,077	$31,300	$97,620	$22,129	$86,028
1999	165	$115,626	$3,705	$94,000	$6,782	$11,138
1998	149	$98,839	$23,624	$4,415	$63,360	$7439
1997	168	$78,228	$13,503	$300	$61,215	$3,213
1996	146	$221,889	$18,778	$4,000	$30,105	
1995	108	$97,184	$36,516	$11,000	$49,668	
1994	86	$62,686	$48,744		$13,942	
1993	46	$259,206	$21,215		$237,991	
1992	7	$59,347	$6,327		$53,020	
TOTAL	2707	$4,102,142	$596,980	$1,784,818	$1,040,673	$686,771

* In-kind includes construction of 7-acre billabong in 1996 ($170,000), donation of 5 acres of bottomland forest in 2001 ($75,000), earthwork and gravel for building construction (2002-03), paved driveway (2003), and civil engineering for building (2003)

** Includes construction of wetlands in 1992-95 ($330,000), Sandefur Wetland Pavilion in 1997-98 ($100,000), bikepath and signage in 2003 ($50,000) and instrumentation required with donations in 2002-03 ($70,000).

Figure 18. Sketch of AEP Olentangy River wetland bikepath shelter planned for city bikepath through Olentangy River Wetland Research Park.

Mitsch, W.J., J.W. Day, Jr., L. Zhang, and R. Lane. 2005d. Nitrate-nitrogen retention by wetlands in the Mississippi River Basin. Ecological Engineering 24: 267-278.

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